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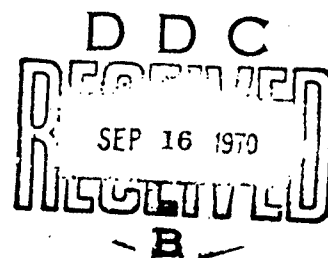
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A MANAGEMENT TECHNIQUE
FOR
IN-HOUSE RESEARCH PROGRAMS

T. J. BAKER

MANAGEMENT
TECHNICAL REPORT AFFDL-MR-70-1

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AIR FORCE FLIGHT DYNAMICS LABORATORY
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

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FOREWORD

This report has been prepared to document the formulation and development of a management technique for use with "in-house" research. Since this management technique has been the subject of a series of lectures, there is a need for a reference document for use by students attending the lectures. This report will serve that purpose.

The reader's attention is directed to the fact that other Divisions of the Air Force Flight Dynamics Laboratory and other Laboratories have different management techniques which are tailored to their individual problems. If the reader is interested in the management of in-house efforts, it is suggested that he seek out these other techniques as well.

This report has been reviewed and is approved.



LEO H. HILDEBRANDT
Chief, Vehicle Equipment Division
AF Flight Dynamics Laboratory

ABSTRACT

This report describes a technique for use in the management of in-house research. This technique has been utilized principally with in-house efforts involving two or three ⁴many years of efforts and small facilities. The technique could be applied to large team efforts but modification would be required. The discussion starts with the initial request from the engineer and each step of the approval and documentation mechanism is covered, including the forms utilized, and ends with a discussion of the display system utilized by management for following progress on each effort. Brief comments are made as to certain fringe benefits which accrue from this technique. Conclusions regarding other needs for management techniques are as presented.

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SECTION I - INTRODUCTION

The increased emphasis on research over the past several years, especially that phase accomplished "in-house", has disclosed a substantial gap in managerial tools. There is no competition for accomplishing a particular piece of research "in-house" as exists when multiple source procedures are used to procure research. This phrase should not be construed to mean that there is no competition between different pieces of research for manpower and dollars. The fact that there is competition for manpower and dollars is the mechanism which highlights the managerial problem.

An "in-house" effort must be evaluated in the same manner as a contracted effort, i.e. "is what I am getting worth the resources (dollars and men) it requires?" In evaluating an "in-house" effort, the assessment of the technical value can be made in the same frame of reference as a contract effort; however, one finds the evaluation of costs a much different problem. In a multiple source procurement, one at least has the advantage of competition in establishing a level of cost. "In-house" research tends to be more parallel to a single source procurement; that is, usually there is only one researcher who is most qualified for a particular proposed effort. One can say why not treat it as such and forget any evaluation of cost. Unfortunately, this reason cannot be accepted. Sole source procurements have to meet a rigorous set of conditions and receive careful review at many levels. Further, because of these reviews and rules, a small percent of contract effort is sole source. In "in-house" research, every effort is a form of sole source. There is not a number of researchers who can do the job and therefore, you could not accept bids for the job from individual "in-house" researchers even if you wanted to. The only solution is to have an accurate estimate of manpower and dollars necessary to do the job.

Here we very quickly come face to face with the real problem, i.e. neither the individual researcher nor his management have a very high degree of capability in estimating what it takes in terms of resources to do a job "in-house". This last statement has been rather firmly proven by some of the previous management systems. In all fairness, it should be stated that the previous systems were only attempting to monitor actual completion versus predicted completion. Manpower and dollars were not a part of the system other than indirectly since missing a milestone indicates possibly a greater expenditure of manpower. Inadequate manpower could cause the same result. It has become very apparent that an adequate job of management cannot be accomplished unless two things are accomplished, namely: (1) a capability has to be developed for estimating the cost (manpower and dollars) of "in-house" efforts and (2) an allocation system is required to assure that adequate manpower and dollars are available. The rest of this report deals with the establishment of a system to accomplish these items. Further, it will be shown that other benefits occur from this system.

SECTION II - GENERAL BACKGROUND

If one is to utilize the technique of trying to assess the cost of an "in-house" effort in terms of its value as a selection criteria, certainly a reliable method of establishing the cost is essential. Unfortunately, the experience level, among "in-house" researchers, in estimating cost is rather limited. This situation exists for two reasons, namely: (1) newness of "in-house" research programs in laboratories and (2) lack of a requirement for such estimates in the past, i.e. do not bother the researcher with such administrative problems. (Certain of the readers will probably say it should still be that way). If one takes a realistic look at the situation, one will soon come to realize that there are benefits which will result for the researcher if he can plan his need for resources. Proper identification of funds and the need for technician or other support will enable management to assure him that adequate support will be available.

Assuming that there is agreement as to the need for such planning, one can now look at ways to obtain such a skill. Unfortunately, there does not appear to be any way of achieving such a skill other than experience, i.e. predict requirements and then see what it takes and then attempt to analyze the reason for the variations.

Therefore, it seems the problem is to develop a systematic method by which the researcher can specify what he wants to do, why he wants to do it, what costs are involved (manpower and dollars) and what discreet element exists which will help him analyze both cost and the time (calendar) that will be required to do it. There is one further requirement and this is a key element. Information must be gathered as to the actual time spent on the effort and dollars expended for support items all against a time reference. Further, it is highly desirable to collect this information with a minimum of work on the part of the researcher.

Fortunately, a basic ingredient of such a system already existed in the AF Flight Dynamics Laboratory, namely, a time accounting system. This system provides data on the most critical element of any in-house plan, i.e. manhours of effort. To this only has to be added a method of tracking support cost (dollars) and an input as to when a milestone has been completed. The system which will provide this additional input must be such as to impose a minimum of additional work on the researcher.

SECTION III - CRITERIA FOR AND DEVELOPMENT OF A SYSTEM

Based on the previous data and some additional analysis, one can establish

the basic criteria for the "complete management". The criteria can be divided into two basic categories, i.e. (1) description of effort and importance and, (2) cost of doing job. This first category can be disposed of quickly by simply stating that the technical value of the program must be conveyed to management so a decision can be made as to whether the program should be undertaken in terms of mission and total cost. The system, however, should achieve this decision with a minimum of expenditure of manhours.

The second category requires more discussion. The following items of information are essential to the proper assessment of the cost of a program:

1. Manyears of direct labor
 - a. Scientific or engineering
 - b. Technician and/or wage board
2. Direct supplies and/or equipment
3. Fabrication
 - a. Shop hours or cost
4. Photographic support
5. Computer
6. Facility usage

Certain of these elements are naturally more important than others and more will be said about this later. However, each of the items does affect the cost of the program to the Air Force even if actual funds are not involved, i.e. the service is at no cost to the activity conducting the program. (Note: current trends indicate that more and more areas of support will come under the service funding concept.) Those items such as supplies and equipment must be considered in the overall budget of the Division and arrangement must be made for the funding support if proper support is to be assured to the individual researchers. Such things as amount of technician or wage board support are also essential to assuring proper support to the effort. There are many more advantages which accrue to the general management areas; however, since they are fringe benefits, they are discussed in a later section.

There is one other vital piece of information needed if the proper support and managerial control is to be possible and that is rate of

resource expenditure. This could be specified on a monthly basis. However, experience has shown that a better approach is to specify milestones and the resource required to complete the milestone. This approach gives a specific point of completion that can be recognized.

There are some cautions that should be conveyed to the reader regarding estimating the manhours and other costs of accomplishing in-house work as well as proper charging of time. Only manhours and expenditures which are necessary for accomplishing the effort should be included in the estimate and only that time and material which contributed to accomplishing the effort should be charged. Preparation of the initial documentation on the effort is a proper charge; however, incorporation of the effort in long range planning documents, furnishing of special reports (AF Form 111 reporting a milestone completion is an exception) are not. Only supplies which are expended on the effort should be charged to the effort. General stocking should be handled under other accounts. Extreme care must be exercised to make sure the original estimate identifies only proper costs and that the time and fiscal procedure assure that all charges made are appropriate.

The establishment of the criteria outline in the previous portion of this section simplified the formation of the tools necessary to accomplishment or provide the desired information. Some of the forms were found to be available and usable from other management areas. When nothing existed, a form was created to do the job. The simplest way to understand the forms, what they achieve and where they fit into the overall system is to discuss each one.

1. FY 70 IH PLAN SHEET (APPENDIX A)

This is the initial or starting point for undertaking an "in-house" effort. The researcher completes the form and forwards it through the chain of command to the approving Division Office (Note: the approval level will vary from organization to organization. Normally the level will be determined by the technical and fiscal control system used. In the author's organization, this level is Division). If after review, the proposed program is determined to be an effort that should be undertaken, the researcher is then requested to prepare the formal documentation. This step fulfills one of the premises stated previously, namely, a system is needed whereby the researcher can have his program reviewed for approval with a minimum of effort on his part.

2. There are a number of forms associated with the "formal" documentation of an "in-house" effort. This "formal documentation"

is not to be confused with the DD Form 1498 Work Unit Documentation System. The researcher must prepare the DD Form 1498; however, the hows, when, whats, etc. are adequately covered in regulations and will not be discussed here. There are several forms which will be discussed in this portion of the report. The order of discussion will be that considered by the author as the most logical sequence for filling out the forms. Other persons may desire to use a different order and that is their prerogative.

a. AFFTL FORM 28 (APPENDIX E)

This form repeats in more detail a description of the effort. It also requires the researcher to break his effort into segments or phases or work. This action serves several functions; namely, provides the researcher and the management a better understanding of what is involved in the effort; provides segments for estimating cost (dollars and manpower); provides intermediate goals for measuring progress and establish a time reference during the fiscal year. The other blocks are self-explanatory with the exception of funding. One might ask why show two years of funding when we are really only talking about one year's effort. This will be discussed in a later section. Basically it provides planning information to the Division.

b. AFFDL FORM 25 (APPENDIX C)

This form is the basic resource form. Here we identify by milestone what is required to do the job. This form provides the basic data necessary for performing the job. The form is fairly self-explanatory. One might ask why are data or resources other than our own required. Under our current method of operating, it serves as a checklist to the researcher as to whether he has forgotten any part of his effort such as photographic support, and provides the Division Office data to answer inquiries from other activities regarding anticipated support. Also these demands, although they do not cost directly (at this time), they are really a part of the Air Force cost of doing the job and must compete for this support with other efforts. One can readily see the value of this information if the service funding concept is applied to more areas.

c. MDF FORM (APPENDIX D)

The forms, discussed previously, and the information they convey appear to adequately describe the "in-house" effort and should be all that is required. This is not true when one remembers that one purpose of this system is to develop a capability for estimating cost of "in-house" effort. Some type of feedback must be available

to all echelons of management and to the engineer as to how well he is accomplishing his job in terms of time and resources. Again, this type of feedback should be provided with a minimum expenditure of time on the part of management and the engineer. To achieve this, a tracking and display technique was developed for use at Division level. In support of this approach, the engineer was asked to plot his resource requirement versus time and milestones as shown in APPENDIX D.

The previous material has outlined what information is gathered from the researcher. Now, a discussion of the system utilized at Division level for closing the loop and providing managerial information will be reviewed. Basically, the system consists of collecting the actual manhours (both Scientific and Engineering and others) as well as actual dollars (support funds) spent and plotting these against the time frame shown in the Card in APPENDIX D. This can be accomplished by the Division Office without assistance since (1) a mechanized Laboratory time accounting system is available and (2) a manual system of tracking support dollars has been in effect from prior years. More explanation of the manual system is probably desirable to insure understanding by the reader. Division approval of all requisitions for supplies and equipment is required. (The various forms involved will not be covered in this report since what form is used for various types of items is incidental to this report). Each request specifies the Work Unit number so the administrative assistant of the Division who processes these requisitions maintains a log of the dollar amount by Work Unit number. Therefore, this record along with the manhour print-out allows the administrative assistant to plot actual values on a monthly basis on the card. The only other piece of information needed is when a milestone has been completed. This information can only come from the researcher. Therefore, as simple as possible a method of reporting was established. All the researcher has to do is verbally notify the Division administrative assistant that a milestone has been completed.

With all the information available, all there is left to discuss is the method of displaying the information. There are a number of possibilities, but after considerable thought, the conclusion was reached that a (Productrol) status board (See Appendix E) probably would be the best approach. The use of such a board permitted the use of a system which could convey considerable amount of information at a mere glance. However, the board could contain additional information in amplification of displayed information. Therefore, a (Productrol) status board which had pockets which would accept the 5 x 8 charts (APPENDIX D) was found. For each chart, the milestone (against a time reference) would be shown in the peg section of the board. The time scale was to be selected so that space would be available for inserting special colored pegs which could convey special information such as

(1) over in estimated manhours, (2) over in estimated dollars, (3) milestone overdue. Therefore, by grouping the "in-house" efforts by organizational elements (Branches in this case) one could quickly scan the status of the "in-house" efforts of interest to him. One other need came to light during a review of this system and that was that a brief discussion of the effort should be written on the reverse side of the card so that one could determine the nature of the effort without consulting the master file of "in-house" efforts. A word or two about the master file might be of value at this point. One copy of the AFFDL Form 25 and AFFDL Form 28 for each "in-house" effort was placed in a three ring loose-leaf notebook. This book served two purposes, namely, it contained full details of the effort if one desired to review it and also served as a place to make notes concerning the effort especially when a technical review was made by Division personnel. This technical review might be of some interest to a reader even though it is not a part of the management system being discussed. An attempt is made to review each effort on an informal basis with the researcher once every three months or at such occasions when progress or over-expenditure of manpower or dollars suggested that a problem existed. This completes the description of the system. There are many varieties that could be used depending on the types of technical efforts, types of displays desired, etc. Basically, the system is intended to serve as a tool for managing "in-house" efforts and improving through experience our capability for predicting what an effort costs and how long it should take.

SECTION IV - TESTING OF THE SYSTEM

A one year service test of the system was accomplished. Basically, this test was directed at obtaining answers to two questions (1) is the system workable, and (2) is it needed? The answer to both questions proved to be yes. Slight corrections were made to the system. However, of much more importance was the answer to the second question. The results clearly proved that we do not have a good capability for predicting what it costs us to do a job. Examples were found where we accomplished a milestone with less than one tenth of the manpower estimated; also, cases where substantially more manpower had been used and the milestone not achieved were encountered. Nearly all efforts missed the time element to complete a milestone. These errors are not interpreted to mean poor technical ability or lack of desire but rather our inability with our current experience to predict what and how long an effort should take. It does, however, clearly indicate to the author that such a system or one similar is mandatory if we are to learn how to conduct and manage "in-house" efforts.

SECTION V - OTHER MANAGERIAL BENEFITS OF THE SYSTEM

Certainly, the reader has noticed that there are other benefits which can be derived from such a system as this. A brief discussion of some of these benefits appears desirable.

1. AFFDL Form 28

The engineer is required to estimate the funds required for the next fiscal year if the program is a continuing one. This data can then be utilized in preparing the budget for the next fiscal year.

2. AFFDL Form 25

a. In addition to AF Flight Dynamics Laboratory manhours, the engineer identifies the support required from external sources. This type of information is of value in answering inquiries from these external organizations regarding the support necessary. This information becomes of extreme value under the service funding concept. As this concept is expanded, these data will be essential for budget purposes.

b. The other and probably the most important feature of this form is that it requires the engineer to assess the support he may need in these various areas. It in effect serves as a check list, but more important to the group leader and Branch Chief, it allows them to ascertain whether he has sufficient manpower resources to support the various programs. Here the plot of manhours versus time on the card (APPENDIX D) also provides a valuable insight to the manhour loading (manhours vs time) which is of vital interest in scheduling work.

3. General Items

The data from such a system also provides a basis for estimating ratios of engineers to support type personnel, dollar support versus manhours, and ratio of external support to internal effort. Data of this type is important to the further improvement of our managerial ability.

SECTION VI - CONCLUSIONS

1. A system for managing "in-house" efforts is essential to proper execution of the program. Proper assessment of the cost of a program is an essential element in determining desirability of conducting the program.

2. This system is not in itself adequate for complete management of Air Force Laboratories. A system for assessing the needs for proper monitoring of contract effort is also essential. Such a system can be developed.

3. Use of the system mentioned in paragraphs 1 and 2, above, with historical data on time, miscellaneous support efforts and system support will provide an improved management system for Air Force Laboratories. Resources can be allocated.

APPENDIX A

FY 7- IN-HOUSE PLAN SHEET

PROJ/TASK NR. _____

TITLE: _____

OBJECTIVE: (What are you going to do? BE BRIEF) _____

WHAT IS THE PAYOFF? _____

TOTAL SUPPORT FUNDS REQUIRED: SUPPLIES & EQUIPMENT _____
TEST SERVICE/SUPPORT _____
AGENCY _____
AGENCY _____
AGENCY _____
TOTAL SUPPORT FUNDS _____

TOTAL MANYEARS* REQUIRED: S&E _____ TECHN _____ WB _____

START DATE: _____ EST. COMPLETION DATE: _____
(1 July 197- or later)




WHAT HAS BEEN ACCOMPLISHED (PARTIALLY COMPLETED EFFORTS ONLY): _____







* One manyear equals 1700 manhours

APPENDIX B

IN-HOUSE PROGRAM REPORT	
TITLE OF EFFORT Low Weight/Cost Parachute	DATE 1 June 1970
PROJECT-TASK-WORK UNIT 1234-01-001	
PROJECT ENGINEER J. Doe	
BRIEF NARRATIVE OF EFFORT (Include Background and Expected Pay-off)	
No example given - self-explanatory	

FY 71												FY 72												TOTAL FUNDS THIS FY (THOUSANDS)
J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	M	D	J	F	M	A	M	J	
3A																								2.4
																								0.5

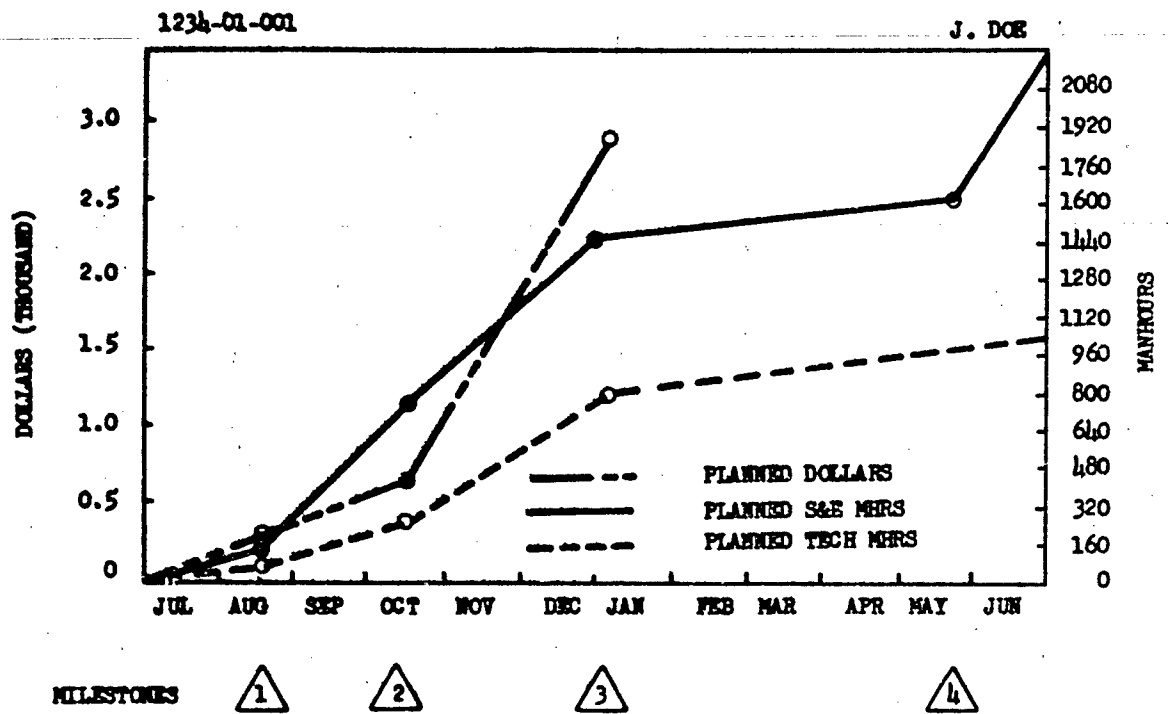
MILESTONES - In the space below list the milestones as briefly as possible. Number them consecutively (e.g., 1, 2, 3, etc.). The scheduled date for accomplishment of each milestone will be indicated in proper space provided on the reverse side (e.g.,  , etc.). The "Start" date for new efforts will be indicated in space provided on the reverse side (e.g., ).

-  - Analysis and development of computer design routine.
-  - Fabrication Test Platform and Test Parachute.
-  - Flight Test completed.
-  - Revision of computer program.
-  - Check Flight Test.
-  - Report prepared.

IN-HOUSE RESEARCH RESOURCE SUMMARY

FORM 25
NOV 66

APPENDIX D



APPENDIX E

